WQB "Wide Aperture Quad" for Main Injector

5 February 2004
ICB HQ conference room
9:00 AM

Attendees: Bruce Brown, Dave Capista, Weiren Chou, TJ Gardner, Dave Harding, Dave Johnson, Vladimir Kashikhin, Ioanis Kourbanis, Lucy Nobrega, François Ostiguy

Dave Harding opened the meeting by reviewing a brief history of the project. Started a couple of years ago when Vladimir Kashikhin was asked to generate a conceptual design based on preliminary data. The project has been on the back burner since then.

This magnet is intended to replace (4) IQB magnets in the Main Injector. The project is considered a high priority for accelerator complex. It is needed to support both NuMI and Switchyard 120 slow spill beam.

The intent is to design, procure, assemble and test (1) prototype magnet by March 2005 for installation as soon thereafter as possible. Production totaling up to (9) units will be needed in time for the 2005 shutdown.

The work on TD's end will be performed by Vladimir Kashikhin, Bill Robotham, and other TD resources as needed.

Weiren Chou presented an overview of the placement and original FMI requirements of that day. The extracted beam passes far too close to the current star shaped beam tube, which at the smallest dimension (pole to pole) measures 3.286". Will the proposed star shaped beam tube, which measures 4" at the pole tip and 6" at the widest, be enough for our current requirements? Will the new magnet require the use of trim coils or a trim power supply adequately track the other Main Injector quadrupoles?

Very rough cost estimates made a couple of years ago suggested that (4) magnets might cost ~$90,000 each (50% labor, 50% M&S) plus ~$350,000 in tooling (~10% labor, ~90% M&S) plus $350,000 in EDIA. TD currently pays for labor while AD would pay for M&S.

The original count was 4 units for the four high energy extraction points, plus spare(s). The injection point at MI10 and the two Recycler transfer points are also candidates for the wide aperture quad, bringing the total (including two spares) to as many as nine magnets.

Dave Johnson provided views of the beam location during circulation and extraction which showed the beam passing far too close to the existing pole tip. This is the premise for this new magnet. A larger aperture allows the Lambertsons to be moved

beyond the center of the quads beam tube offering a better use of the Lambertsons field free region for circulating beam.

As this magnet design replaces IQB's at specific locations in the ring, the envelope for the replacement magnet is limited. Although no additional length can be provided, limited additional height and width might be afforded. Lucy will take maximum measurements as access to the tunnel allows. If a new stand is required, Mechanical Support will provide that effort. The conceptual drawing shows 26" for both the width and height of the magnet. Lucy also advised that the magnets beam tube flanges must continue to use the current design as depicted by drawing MB 23279 (standard 6" flange).

Dave Johnson continued with the magnet requirements:
- Must run on the QF quad bus (except at Q101)
- Same GL vs current as 84" quad
- Pole tip diameter of 4"
- Star chamber w/~6" H and V aperture
- Same Harmonics as IQB- Same acceptance criteria
- MI needs to determine tolerance on harmonics and GdL tracking with current
- RMS strength variation of IQB 6 units => .3% beta wave OK.

Vladimir Kashikhin displayed his calculations of field strength and pole. The combination of required aperture and gradient implies a pole tip field of 2 Tesla. This means that the magnet is going to behave differently from the existing quads regardless of what is done to its core. His diagram for the magnet utilized the same copper as the IQB. 6 turns per quadrant with the copper wound sideways and a four core configuration. Vladimir will continue his calculations to determine how much current would be required.

Action items:

Dave Johnson will continue to review his calculations of the magnet requirements and magnet quantities. The basic questions are 1) How well does this magnet need to track the others? Can we live with it as is or do we need a trim power supply? 2) What field uniformity is required?

Weiren will discuss with EE whether they prefer a trim power supply on the bus or a separate trim coil with its own power supply. Also, will the different magnet properties cause any difficulties on the bus?

Vladimir will review his calculation for the magnet model, use Armco steel rather than LTV steel, and work with Bill Robotham to arrange for detail drawings and eventual procurement. Vladimir

will also provide a copy of the magnet cross-section drawing to AD for comparison to the tunnel space.

Dave Harding will formalize project priorities and solicit TD resources.

TJ Gardner will develop a schedule for the project.

The next meeting will be held on 19 February 2004 at 900-1030 in the IB2 conference room.